

Appendix B-1

Roadway Sector WIST Needs Template

Roadway Sector Activities

Road maintenance. This activity is generally where the requirements of the state transportation departments are compiled. It includes road surface treatment for snow and ice control in the winter, as well as road and infrastructure maintenance year-round to repair damage.

Truck operations. The primary example for this activity is commercial trucking operations, both local and long haul.

Fleet utility and transport vehicle operations. This activity includes small to medium size fleets of utility vehicles, such as those maintained by telephone or cable television companies, as well as the large, nationwide fleets of mail and parcel delivery vehicles.

Bus operations. This activity is intended to cover primarily long-haul bus operations, such as interstate travel, rather than school buses or local transit system buses, both of which are covered by the Rural and Urban Transit Operations sector.

Private vehicle operations. Private vehicle operators, daily commuters, long-distance travelers, and local drivers, as well as rental car operators, are included in this activity.

State/local emergency managers. This activity encompasses emergency managers at state and local levels.

State police. Although state police and highway patrol entities provided the input on WIST needs for this activity, the information is generally valid for law enforcement and public safety officials anywhere with roadway traffic safety responsibilities.

Forest Service. The roadway operations of the U.S. Forest Service role are limited to unimproved roads under its jurisdiction within national forests and grasslands. But the ways in which the weather affects these roads has major impact on all the uses of these areas.

Special Groups

NASA spacecraft and equipment transport. NASA's principal concern with roadways is in transporting spacecraft and components by land routes between its various centers and the launch facilities.

Power generating operations. The WIST needs of the power marketing administrations (see Section 3.1.2) are limited to road conditions that affect the ability of repair crews in utility vehicles to reach transmission lines and facilities.

Manufactured home transport. This specialized activity has WIST needs that represent the general class of high-profile vehicles, which have special sensitivities to wind and other weather elements, such as those that affect tire traction.

Weather Needs for Roadway Transportation

<u>Weather Element</u>	<u>Threshold</u>	<u>Activity</u>	<u>Impacts</u>	<u>Action</u>	<u>Lead Time</u>
Freezing Precipitation (ice)	Any	Road maintenance	Safety risk to maintenance personnel and motorists, travel delays, loss of visibility, loss of traction, loss of stability/maneuverability, lane obstruction, impaired mobility, road damage, loss of life, property damage, loss of communications/power, slope instability (avalanche risk)	Advise operators, begin preparation procedures, warn the public through press releases to ensure public awareness and allow adjustment to travel plans. Predict threatened area, select treatment strategy.	24-48 hours (starting time of event is critical to DOT operations)
			Operational and travel delays, increased workload	Anti-icing, de-icing treatment of roadways. Prepare, deploy and track treatment assets. Apply treatment chemicals/abrasives, manage traffic flow. Remove debris and repair damage.	3-6 hours
		Truck operations	Safety risk to operators, freight/cargo damage risk, schedule delays, increased risk of collisions/spills of hazardous cargo	Advise operators and managers, conduct risk assessment. Delay, postpone, reschedule, or reroute as appropriate. If underway, especially when hauling hazardous materials, find a safe stopping point.	12 hours
		Driveaway-towaway (manufactured home transport)	Possible loss of control, endangering other drivers	Advise operators and reduce speed or stop, if necessary.	6 hours
		NASA (Goddard) spacecraft and equipment transport	Safety risk to transport vehicle operators, damage risk to unique cargo (spacecraft, vehicles, equipment), transport schedule delays, potential launch schedule delays	Advise transport operators, slow movement speeds when roads have been treated for ice, reroute (long haul) or delay movement. Preposition cargo at air transport site and transport earlier to avoid weather impacts.	48 hours
		Fleet utility and transport vehicle operations	Safety risk to operators, damage risk, schedule delays	Advise operators, reschedule, or reroute.	12 hours
		Bus operations	Increased safety risk to operators and passengers, injuries and resulting claims, traffic congestion, routes may require detours, delays of scheduled operations, traffic accidents, increased risk of damage to busses/property	Implement preparation procedures, reschedule, reroute. Advise operators to drive with extreme caution, modify or restrict operations (especially on hills), suspend operations as appropriate. Advise passengers via bus radio system. Clear station parking lots and platforms.	12-24 hours
		Private vehicles	Safety risk to motorists, travel delays	Advise motorists, reschedule, reroute.	12 hours
		State emergency management	Safety risk to motorists, hazardous cargo risks	Advise operators, reschedule.	12 hours
		State police	Increased workload due to hazardous travel conditions	Advise operators, reschedule, adjust traffic management.	12 hours
		U.S. Forest Service	Closed roads, blocked roads, recreationists (e.g. hikers, campers) trapped or stranded, threats to safety and survival	Warn campers/hikers to evacuate threatened area. Initiate search and rescue operations if necessary. Repair/reopen closed roads.	24-48 hours
Power generating operations	Impaired mobility of commuters and line repair operations, line repair accomplished by overland dispatch of personnel, potential for "line conductor galloping" (a power distortion that may occur during transition of precipitation from rain to wet snow and then to snow or ice)	Alert and advise commuters and line repair personnel.	24-72 hours		
Structure Ice Accumulation (inches)	Any	Road maintenance	Loss of communications/power, property and structural damage, safety risk	Select and implement treatment strategy. Remove debris and repair damage.	Current observation

Weather Needs for Roadway Transportation

<u>Weather Element</u>	<u>Threshold</u>	<u>Activity</u>	<u>Impacts</u>	<u>Action</u>	<u>Lead Time</u>
Pavement Ice Accumulation (inches)	Any	Road maintenance	Impaired mobility, loss of stability/maneuverability, loss of traction, pavement damage, pavement temperature, safety risk, snow removal/ice treatment operations	Select and implement snow removal and/or ice treatment strategy. Remove debris and repair damage.	Current observation
Frozen Precipitation (snow, inches)	Any to <2	Road maintenance	Safety risk to maintenance personnel and motorists, travel delays, loss of visibility, loss of traction, loss of stability/maneuverability, lane obstruction, impaired mobility, road damage, loss of life, property damage, slope instability (avalanche risk)	Advise operators, begin preparation procedures for equipment, crew planning, shift changes, geographical reassignment and deployment. Warn public through press releases to ensure public awareness and allow adjustments to travel plans. Predict threatened area, select treatment strategy.	24-48 hours (starting time of event is critical to DOT operations)
			Operational delays, increased workload	Conduct snow fighting operations. Prepare, deploy and track treatment assets. Apply treatment chemicals/abrasives, manage traffic flow.	3-6 hours
		Truck operations	Safety risk to operators, freight/cargo damage risk, schedule delays, increased risk of collisions/spills of hazardous cargo	Advise operators and managers, conduct risk assessment. Delay, postpone, reschedule, or reroute as appropriate. If underway, especially when hauling hazardous materials, find a safe stopping point.	12 hours
		Driveaway-towaway (manufactured home transport)	Possible loss of control, danger other drivers.	Advise operators and reduce speed or stop if necessary.	6 hours
		NASA (Goddard) spacecraft and equipment transport	Safety risk to transport vehicle operators, damage risk to unique cargo (spacecraft, vehicles, equipment), transport schedule delays, potential launch schedule delays	Advise transport operators, plan for decreased movement speeds, reroute (long haul) or delay movement. Preposition cargo at air transport site and transport earlier to avoid weather impacts.	48 hours
		Fleet utility and transport vehicle operations	Safety risk to operators, damage risk, schedule delays	Advise operators, reschedule, reroute.	12 hours
		Bus operations	Increased safety risk to operators and passengers, injuries and resulting claims, traffic congestion, vehicle damage risk, routes may require detours, delays of scheduled operations, traffic accidents, increased risk of damage to busses/property, delays of facility maintenance	Advise operators, reschedule, reroute. Advise operators to drive with extreme caution. Modify, restrict operations (especially on hills), suspend operations (in some regions). Advise passengers via bus radio system. Clear station parking lots and platforms.	12 hours
		Private vehicles	Safety risk to motorists, travel delays	Advise motorists, reschedule, reroute.	12 hours
		State emergency management	Safety risk to motorists, hazardous cargo	Advise operators, reschedule.	12 hours
		State police	Increased workload due to hazardous travel conditions	Advise operators, reschedule, adjust traffic management.	12 hours
		U.S. Forest Service	No significant impact	Advise recreationists.	12 hours
Power generating operations	Impaired mobility of commuters and line repair operations, line repair accomplished by overland dispatch of personnel, potential for "line conductor galloping" (a power distortion that may occur during transition of precipitation from rain to wet snow and then to snow or ice)	Alert and advise commuters and line repair personnel.	24-72 hours		
Frozen Precipitation (snow, inches)	≥2 to <8	Road maintenance	Safety risk to maintenance personnel and motorists, travel delays, loss of visibility, loss of traction, loss of stability/maneuverability, lane obstruction, impaired mobility, road damage, loss of life, property damage, slope instability (avalanche risk)	Advise operators, begin preparation procedures for equipment, crew planning, shift changes, geographical reassignment and deployment. Warn public through press releases to ensure public awareness and allow adjustments to travel plans. Predict threatened area, select treatment strategy.	24-48 hours (starting time of event is critical to DOT operations)

Weather Needs for Roadway Transportation

<u>Weather Element</u>	<u>Threshold</u>	<u>Activity</u>	<u>Impacts</u>	<u>Action</u>	<u>Lead Time</u>
				Prepare, deploy, and track treatment assets. Apply treatment chemicals/abrasives, plow snow. Manage traffic flow, implement tire chain controls, restrict access to designated vehicle types, restrict access to roadways/bridges.	3-6 hours
		Truck operations	Safety risk to operators, freight/cargo damage risk, schedule delays, increased risk of collisions/spills of hazardous cargo	Advise operators and managers, conduct risk assessment. Delay, postpone, reschedule, or reroute as appropriate. If underway, especially when hauling hazardous materials, find a safe stopping point.	12 hours
		Driveaway-towaway (manufactured home transport)	Possible loss of control, danger to other drivers	Advise operators. Reduce speed or stop if necessary.	6 hours
		NASA (Goddard) spacecraft and equipment transport	Safety risk to transport vehicle operators, damage risk to unique cargo (spacecraft, vehicles, equipment), transport schedule delays, potential launch schedule delays	Advise transport operators, plan for decreased movement speeds, reroute (long haul) or delay movement. Preposition cargo at air transport site and transport earlier to avoid weather impacts.	48 hours
		Fleet utility and transport vehicle operations	Safety risk to operators, damage risk, schedule delays	Advise operators, reschedule, reroute.	12 hours
		Bus operations	Increased safety risk to operators, passenger injuries and resulting claims, traffic congestion, vehicle damage risk, routes may require detours, delays of scheduled operations, traffic accidents, increased risk of damage to busses/property, delayed facility maintenance	Advise operators, reschedule, reroute. Advise operators to drive with extreme caution, modify or restrict operations (especially on hills), suspend operations (in some regions). Advise passengers via bus radio system. Clear station parking lots and platforms.	12-24 hours
		Private vehicles	Safety risk to motorists, travel delays	Advise motorists, reschedule, reroute.	12 hours
		State emergency management	Safety risk to motorists, hazardous cargo	Advise operators, reschedule.	12 hours
		State police	Increased workload due to hazardous travel conditions	Advise operators, reschedule, adjust traffic management.	12 hours
		U.S. Forest Service	No significant impact	Advise recreationists.	12 hours
		Power generating operations	Impaired mobility of commuters and line repair operations, line repair accomplished by overland dispatch of personnel, potential for "line conductor galloping" (a power distortion that may occur during transition of precipitation from rain to wet snow and then to snow or ice)	Alert and advise commuters and line repair personnel.	24-72 hours
Frozen Precipitation (snow, inches)	≥8	Road maintenance	Safety risk to maintenance personnel and motorists, travel delays, loss of visibility, loss of traction, loss of stability/maneuverability, lane obstruction, impaired mobility, road damage, loss of life, property damage, loss of communications/power, slope instability (avalanche risk)	Advise operators, begin preparation procedures for equipment, crew planning, shift changes, geographical reassignment and deployment. Warn the public through press releases to ensure public awareness and allow adjustments to travel plans. Predict threatened area, select treatment strategy.	24-48 hours (starting time of event is critical to DOT operations)
				Implement snow fighting, tire chain control operations. Prepare, deploy, and track treatment assets. Apply treatment chemicals/abrasives, plow snow. Manage traffic flow (restrict access to designated vehicle types, restrict access to roadways/bridges, close roadways/bridges).	3-6 hours

Weather Needs for Roadway Transportation

<u>Weather Element</u>	<u>Threshold</u>	<u>Activity</u>	<u>Impacts</u>	<u>Action</u>	<u>Lead Time</u>
		Truck operations	Safety risk to operators, freight/cargo damage risk, schedule delays, increased risk of collisions/spills of hazardous cargo	Advise operators and managers, conduct risk assessment. Delay, postpone, reschedule, or reroute as appropriate. If underway, especially when hauling hazardous materials, find a safe stopping point.	12 hours
		Fleet utility and transport vehicle operations	Safety risk to operators, damage risk, schedule delays	Restrict or suspend operations, reschedule, reroute.	12 hours
		NASA (Goddard) spacecraft and equipment transport	Safety risk to transport vehicle operators, damage risk to unique cargo (spacecraft vehicles, equipment), transport schedule delays, potential launch schedule delays	Advise transport operators, slow movement speeds when roads have been plowed, reroute (long haul) or delay movement. Preposition cargo at air transport site and transport earlier to avoid weather impacts.	48 hours
		Bus operations	Increased safety risk to operators, passenger injuries and resulting claims, traffic congestion, vehicle damage risk, routes may require detours, delays of scheduled operations, traffic accidents, increased risk of damage to busses/property, delayed facility maintenance	Advise operators, begin preparation procedures to implement snow routes. Put snow routes into effect as appropriate. Advise operators to drive with extreme caution. Modify or restrict operations (especially on hills), suspend operations as appropriate. Advise passengers via bus radio system. Clear station parking lots and platforms.	12-24 hours
		Private vehicles	Safety risk to motorists, travel delays	Restrict/suspend travel, reschedule, reroute	12 hours
		State emergency management	Safety risk to motorists, hazardous cargo	Advise operators, reschedule.	12 hours
		State police	Increased workload due to hazardous travel conditions	Advise operators, reschedule, adjust traffic management.	12 hours
	≥8 (primarily significant early snowfall)	U.S. Forest Service	Closed roads, blocked roads, recreationists (e.g. hikers, campers) trapped or stranded, threats to safety and survival	Warn campers/ hikers to evacuate threatened area. Initiate search and rescue operations if necessary. Repair/reopen closed roads.	24-48 hours
	≥8	Power generating operations	Impaired mobility of commuters and line repair operations, line repair accomplished by overland dispatch of personnel, potential for "line conductor galloping" (a power distortion that may occur during transition of precipitation from rain to wet snow and then to snow or ice)	Alert and advise commuters and line repair personnel.	24-72 hours
	Drifting Snow (inches, must include wind speed and direction)	Any	Road maintenance	Safety risk to maintenance personnel and motorists, travel delays, loss of visibility, loss of traction (Winds >15 mph can lead to blowing snow and drifting in some areas. The amount of snow already on the ground may not be the determining factor; if snow storage areas are full, even a few inches can cause drifting problems. Drifting snow can cause continuous and prolonged clearing operations, which strain manpower resources.)	Consider road closures and treatment strategy. Begin preparation procedures for equipment, crew planning, shift changes, geographical reassignment and deployment. Warn public through press releases to ensure awareness and allow adjustment to travel plans. Predict threatened area. Construct and place living and structural snow fences.
≥8			Operational delays, increased workload, loss of visibility, loss of traction, lane obstruction, impaired mobility	Select treatment strategy. Implement snow fighting and tire chain control operations. Prepare, deploy, and track treatment assets. Plow snow, apply treatment chemicals/abrasives. Modify lane configuration, Manage snow removal/ice treatment operations.	3-6 hours
≥8		Truck operations	Safety risk to operators, freight/cargo damage risk, schedule delays, increased risk of collisions/spills of hazardous cargo	Advise operators and managers, conduct risk assessment. Delay, postpone, reschedule, or reroute as appropriate. If underway, especially when hauling hazardous materials, find a safe stopping point.	12 hours

Weather Needs for Roadway Transportation

<u>Weather Element</u>	<u>Threshold</u>	<u>Activity</u>	<u>Impacts</u>	<u>Action</u>	<u>Lead Time</u>
		Fleet utility and transport vehicle operations	Safety risk to operators, damage risk, schedule delays	Restrict or suspend operations, reschedule, reroute.	12 hours
		NASA (Goddard) spacecraft and equipment transport	Safety risk to transport vehicle operators, damage risk to unique cargo (spacecraft, vehicles, equipment), transport schedule delays, potential launch schedule delays	Advise transport operators, slow movement speeds when roads have been plowed, reroute (long haul) or delay movement. Preposition cargo at air transport site and transport earlier to avoid weather impacts.	48 hours
		Bus operations	Increased safety risk to operators, passenger injuries and resulting claims, traffic congestion, vehicle damage risk, routes may require detours, delays of scheduled operations, traffic accidents, increased risk of damage to busses/property	Advise operators, begin preparation procedures to implement snow routes. Put snow routes into effect as appropriate. Advise operators to drive with extreme caution. Modify or restrict operations (especially on hills), suspend operations as appropriate. Advise passengers via bus radio system. Clear station parking lots and platforms.	12-24 hours
		Private vehicles	Safety risk to motorists, travel delays	Restrict or suspend travel, reschedule, reroute.	12 hours
		State emergency management	Safety risk to motorists, hazardous cargo	Advise operators, reschedule.	12 hours
		State police	Increased workload due to hazardous travel conditions	Advise operators, reschedule, adjust traffic management.	12 hours
		Power generating operations	Impaired mobility of commuters and line repair operations, line repair accomplished by overland dispatch of personnel, potential for "line conductor galloping" (a power distortion that may occur during transition of precipitation from rain to wet snow and then to snow or ice)	Alert and advise commuters and line repair personnel.	24-72 hours
Snow Accumulation Observation (inches)	Any	Road maintenance	Drifting snow, impaired plowing, lane obstruction, loss of stability/maneuverability, loss of traction, effects of pavement temperature on snow pack, slope instability (avalanche risk)	Prepare, deploy, and track treatment assets. Apply treatment chemicals/abrasives, manage traffic flow. Remove debris and repair damage.	Current observation
Snow Drift Levels Observation (inches)	Any	Road maintenance	Impaired plowing, lane obstruction	Select treatment strategy.	Current observation
Roadway Snow Depth Observation (inches)	Any	Road maintenance	Loss of traction, impaired mobility, effects on snow removal/ice treatment operations	Select treatment strategy.	Current observation
Roadway Snow Pack Depth Observation (inches)	Any	Road maintenance	Loss of traction, impaired mobility, effects on snow removal/ice treatment operations	Select treatment strategy.	Current observation
Adjacent Snow Depth Observation (inches)	Any	Road maintenance	Drifting snow, roadway snow depth	Select treatment strategy.	Current observation
Snow/Ice Bonding Observation (inches)	Any	Road maintenance	effects on snow removal/ice treatment operations	Select treatment strategy.	Current observation
Liquid Precipitation (inches)	Any	Road maintenance	Safety risk, maintenance activity delays, DOT operational activity delays, public travel delays, loss of visibility, decreased traction and stability/maneuverability, lane obstruction or submersion, road	Advise operators, travelers, planning activities. Predict threatened area. Begin preparation procedures. Induce drainage where blocked. Finalize decisions.	12-24 hours 6 hours
	Heavy	Truck operations	Safety risk to operators, freight/cargo damage risk, schedule delays, increased risk of collisions/spills of hazardous cargo	Advise operators and managers, conduct risk assessment. Delay, postpone, reschedule, or reroute as appropriate. If underway, especially when hauling hazardous materials, find a safe stopping point.	12 hours

Weather Needs for Roadway Transportation

Weather Element	Threshold	Activity	Impacts	Action	Lead Time
	Any	Driveaway-towaway (manufactured home transport)	Possible loss of control, danger to other drivers	Some states prohibit travel if roadway is wet.	6 hours
	Heavy	Fleet utility and transport vehicle operations	Safety risk, schedule delays	Modify/restrict operations, reschedule, reroute.	12 hours
	Heavy	NASA (Goddard) spacecraft and equipment Transport	Safety risk to transport vehicle operators, damage risk to unique cargo (spacecraft, vehicles, equipment), transport schedule delays, potential launch schedule delays	Advise transport operators, slow movement speeds, reroute (long haul) or delay movement. Preposition cargo at air transport site and transport earlier to avoid weather impacts.	48 hours
	Heavy	Bus operations	Increased safety risk, traffic congestion, vehicle damage risk, routes may require detours, delays of scheduled operations, traffic accidents, increased risk of damage to busses/property, delayed maintenance of facilities, fleet, and bus stops	Modify or restrict operations (reschedule, reroute). Advise operators of wet road conditions or areas of pooling water. Advise operators to drive with extreme caution.	12-24 hours
	Heavy	Private vehicles	Safety risk, travel delays	Modify or restrict travel, reschedule, reroute.	12 hours
	Heavy	State emergency management	Safety risk to motorists, hazardous cargo	Advise operators, reschedule.	12 hours
	Heavy	State police	Increased workload due to hazardous travel conditions	Advise operators, reschedule, adjust traffic management.	12 hours
	Heavy	U.S. Forest Service	Safety risk to motorists, storm water on roadways, culverts washed away by down-hill cascading, roads washed away, recreational activities and timber cutting halted, people trapped in remote areas	Initiate storm patrols. Pre-stage equipment and personnel to prevent damage during rain event. Move in equipment after event for emergency repairs to rebuild roadways.	24 hours
Precipitable Water Vapor Observation (inches)	Any	Observation (by satellite imagery interpretation)	Precipitation patterns and rates	Predict threatened area, select treatment strategy.	Current observation
Flooding	Any	Road maintenance	Safety risks, road submersion, loss of life and property, road damage, bridge damage, travel delays	Begin preparations, plan detour routes. Plan for contingencies, issue alerts. Conduct local mobilization. Advise travelers, close roads, prepare to monitor/induce drainage.	1-2 weeks 12-24 hours 6-12 hours
		Truck operations	Safety risk to operators, freight/cargo damage risk, schedule delays, increased risk of collisions/spills of hazardous cargo	Advise operators and managers, conduct risk assessment, Delay, postpone, reschedule, reroute as appropriate.	12 hours
		Driveaway-towaway (manufactured home transport)	Impassable roads	Avoid flooded areas.	12 hours
		Fleet utility and transport vehicle operations	Safety risk, schedule delays	Restrict or suspend operations, reschedule, reroute.	12 hours
		NASA (Goddard) spacecraft and equipment transport	Safety risk to transport vehicle operators, damage risk to unique cargo (spacecraft/vehicles/equipment), transport schedule delays, potential launch schedule delays	Advise transport operators, slow movement speeds, reroute (long haul) or delay movement. Preposition cargo at air transport site and transport earlier to avoid weather impacts.	48 hours
		Bus operations	Increased safety risk, traffic congestion, vehicle damage risk, routes may require detours, traffic accidents, increased risk of damage to busses/property, delayed or suspended bus service in affected areas, notification of road authorities and public relations required	Restrict, reschedule, reroute, or suspend operations. Advise operators, roadway authorities, and public relations of real time road conditions. Divert routes where flooding may be occurring or the risk of flooding is high.	12 - 24 hours
		Private vehicles	Safety risk, travel delays	Restrict or suspend travel, reschedule, reroute.	12 hours

Weather Needs for Roadway Transportation

<u>Weather Element</u>	<u>Threshold</u>	<u>Activity</u>	<u>Impacts</u>	<u>Action</u>	<u>Lead Time</u>
		State emergency management	Safety risk to motorists, hazardous cargo	Advise operators, reschedule.	24 hours
		State police	Increased workload due to hazardous travel conditions	Advise operators, reschedule, adjust traffic management.	12 hours
		U.S. Forest Service	Safety risk to motorists, storm water on roadways, culverts washed away by down-hill cascading, roads washed away, recreational activities and timber cutting halted, people trapped in remote areas	Initiate storm patrols. Pre-stage equipment and personnel to prevent damage during rain event. Move in equipment after event for emergency repairs to rebuild roadways.	24 hours
Thunderstorms with Lightning (proximity to route or operational area in miles)	≤5 miles	Road maintenance	Loss of life, property damage, loss of communications/power, safety risk, maintenance activity delays, travel delays	Advise operators, advise travelers.	6-12 hours
				Cease refueling, restrict or suspend outdoor operations	3-6 hours
		Truck operations	Safety risk to operators, freight/cargo damage risk, schedule delays, increased risk of collisions/spills of hazardous cargo	Advise operators and managers, conduct risk assessment. Delay, postpone, reschedule, or reroute as appropriate. If underway, especially when hauling hazardous materials, find a safe stopping point.	3 hours
		Fleet utility and transport vehicle operations	Safety risk, damage risk, operational delays	Advise operators, cease refueling, restrict or suspend outdoor activities.	3 hours
		NASA (Goddard) spacecraft and equipment transport	Safety risk to transport vehicle operators, damage risk to unique cargo (spacecraft, vehicles, equipment), transport schedule delays	Advise transport operators, reroute (long haul) or delay movement. If underway, take evasive actions as appropriate.	3 hours
		Bus operations	Safety risk, damage risk, operational delays	Advise operators, cease refueling, restrict or suspend outdoor activities.	3 hours
		Private vehicles	Safety risk, damage risk, travel delays	Advise operators, cease refueling, restrict or suspend outdoor activities.	3 hours
		State emergency management	Safety risk, damage risk, hazardous cargo vulnerability	Advise operators, cease refueling, restrict or suspend outdoor activities.	3 hours
		State police	Increased workload due to hazardous travel conditions	Advise operators, cease refueling, restrict or suspend outdoor activities.	3 hours
		U.S. Forest Service	Safety risk to workforce, often no communications mechanism to get lightning warnings to forest service workers (Workers sometime travel as much as 2 days into remote forest areas.)	When communications (e.g. Forest Service radio) are available, advise field personnel to take cover.	3 hours
	Any	Power generating operations	efficient power transmission impaired or interrupted	Alert operators and line repair personnel.	24 hours
Thunderstorms with Hail (hail size and proximity to route or operational area)	Any size, ≤5 miles	Road maintenance	Safety risks and travel delays, loss of visibility, loss of traction, impaired mobility, lane obstruction, loss of life/property, loss of communications/power	Predict threatened area, prepare to implement warning and evacuation plans, advise travelers.	6-12 hours
				Select treatment strategy, advise operators and travelers.	3-6 hours
	>1/4 inch, ≤5 miles	Road maintenance	Safety risk, hail damage	Advise operators, suspend outdoor operations.	3-6 hours
	Any size, ≤5 miles	Truck operations	Safety risk to operators, freight/cargo damage risk, schedule delays, increased risk of collisions/spills of hazardous cargo	Advise operators and managers, conduct risk assessment. Delay, postpone, reschedule, or reroute as appropriate. If underway, especially when hauling hazardous materials, find a safe stopping point.	3-6 hours
		Driveaway-towaway (manufactured home transport)	Possible hail damage to manufactured home	Change route and/or adjust speed to avoid storm.	3-6 hours
		Fleet utility and transport vehicle operations	Safety risk, hail damage, schedule delays	Advise operators, suspend travel, reroute.	3-6 hours

Weather Needs for Roadway Transportation

<u>Weather Element</u>	<u>Threshold</u>	<u>Activity</u>	<u>Impacts</u>	<u>Action</u>	<u>Lead Time</u>	
		NASA (Goddard) spacecraft and equipment transport	Safety risk to transport vehicle operators, damage risk to unique cargo (spacecraft, vehicles, equipment), transport schedule delays	Advise transport operators, reroute (long haul) or delay movement. If underway, take evasive actions as appropriate.	3-6 hours	
		Bus operations	Safety risk, hail damage, schedule delays	Advise operators, suspend travel, reroute.	3-6 hours	
		Private vehicles	Safety risk, hail damage, travel delays	Advise motorists, suspend travel, reroute.	3-6 hours	
		State emergency management	Safety risk, hail damage	Advise operators, suspend outdoor activities.	3-6 hours	
		State police	Increased workload due to hazardous travel conditions	Advise operators, suspend outdoor activities.	3-6 hours	
		U.S. Forest Service	Safety risk to workforce, often no communications mechanism to get hail warnings to forest service workers (Workers sometime travel as much as 2 days into remote forest areas.)	When communications (e.g. Forest Service radio) are available, advise field personnel to take whatever cover is available.	3-6 hours	
		Any size, <5 miles	Power generating operations	Impairs or interrupts efficient power transmission	Alert operators and line repair personnel.	24 hours
Thunderstorms with Tornado (proximity to route or operational area in miles)	≤10 miles	Road maintenance	Safety risks and travel delays, loss of visibility, loss of traction, impaired mobility, lane obstruction, loss of life and property, loss of communications/power	Predict threatened area, advise operators and travelers. Review and implement warning and evacuation plans.	6-12 hours	
				Advise operators and travelers, suspend outdoor operations.	3-6 hours	
	≤20 miles	Truck operations	Safety risk to operators, freight/cargo damage risk, schedule delays, increased risk of collisions/spills of hazardous cargo	Advise operators and managers, conduct risk assessment. Delay, postpone, reschedule, or reroute as appropriate. If underway, especially when hauling hazardous materials, find a safe stopping point.	3-6 hours	
		Driveaway-towaway (manufactured home transport)	Loss of driver and cargo	Avoid at all costs.	3-6 hours	
		Fleet utility and transport vehicle operations	Safety risk, damage to cargo, schedule delays	Advise operators, suspend travel, reroute.	3-6 hours	
		NASA (Goddard) spacecraft and equipment transport	Safety risk to transport vehicle operators, damage risk to unique cargo (spacecraft, vehicles, equipment), transport schedule delays	Advise transport operators, reroute (long haul) or delay movement. If underway, take evasive actions as appropriate.	3-6 hours	
		Bus operations	Safety risk, damage to cargo, schedule delays	Advise operators, suspend travel, reroute.	3-6 hours	
		Private vehicles	Safety risk, damage, travel delays	Advise motorists, suspend travel, reroute.	3-6 hours	
		State emergency management	Safety risk, damage	Advise operators, suspend outdoor activities.	3-6 hours	
		State police	Increased workload due to hazardous travel conditions	Advise operators, suspend outdoor operations.	3-6 hours	
		U.S. Forest Service	Access roads blocked by debris and fallen timber, valuable timber blown down (Downed timber requires timely salvage before its value is lost.)	Respond immediately to clear roadways. Plan for timely salvage of downed timber.	3-6 hours	
		Observation	U.S. Forest Service	Blocked roads, downed valuable timber	Determine where downed timber and blocked roads may have occurred in remote areas without depending on visual observations and field reports. Determine tracking using weather radar, etc.	Current observation
Severe Storm Cell Track—Location, Direction, Speed, Severity (proximity to route or operational area in miles)	≤20 miles	Road maintenance	Credibility of evacuation orders, flood risk, loss of life, property damage, road damage, loss of visibility, loss of traction, impaired mobility, lane obstruction/ submersion, loss of communications/power	Predict threatened area, select treatment strategy, mobilize maintenance personnel, implement warning and evacuation plans, issue evacuation orders, operate outflow devices, manage traffic flow. Remove debris, repair damage.	1-3 hour forecast and current observation	

Weather Needs for Roadway Transportation

<u>Weather Element</u>	<u>Threshold</u>	<u>Activity</u>	<u>Impacts</u>	<u>Action</u>	<u>Lead Time</u>
		Truck operations	Safety risk to operators, freight/cargo damage risk, schedule delays, increased risk of collisions/spills of hazardous cargo	Advise operators and managers, conduct risk assessment. Delay, postpone, reschedule, or reroute as appropriate. If underway, especially when hauling hazardous materials, find a safe stopping point.	Current observation
		U.S. Forest Service	Trapped, stranded, injured recreationists	Issue warnings and advisories. Implement evacuation or search and rescue plans as necessary.	Current observation
		NASA (Goddard) spacecraft and equipment transport	Safety risk to transport vehicle operators, damage risk to unique cargo (spacecraft, vehicles, equipment), transport schedule delays	Advise transport operators, reroute (long haul) or delay movement. If underway, take evasive actions as appropriate.	Current observation
Major Storms					
Blizzard—35 mph Sustained Winds, Visibility \leq 1/4 mile, Blowing Snow (proximity to route or operational area in miles)	\leq 50 miles	Road maintenance	Safety risks and travel delays, loss of visibility, loss of traction, impaired mobility, lane obstruction/submersion, loss of life, property damage, loss of communications/power	Predict threatened area, advise operators and travelers suspend outdoor operations, select treatment strategy. Implement warning and evacuation plans, mobilize maintenance forces.	48-96 hour forecast and current observation
		Truck operations	Safety risk to operators, freight/cargo damage risk, schedule delays, increased risk of collisions/spills of hazardous cargo	Advise operators and managers, conduct risk assessment. Delay, postpone, reschedule, reroute as appropriate. If underway, especially when hauling hazardous materials, find a safe stopping point.	48-96 hour forecast and current observation
		U.S. Forest Service	Trapped, stranded, injured recreationists	Issue warnings and advisories. Implement search and rescue and evacuation plans as necessary.	48-96 hour forecast and current observation
		NASA (Goddard) spacecraft and equipment transport	Safety risk to transport vehicle operators, damage risk to unique cargo (spacecraft, vehicles, equipment), transport schedule delays, potential launch schedule delays	Advise transport operators, slow movement speeds when roads have been treated for ice conditions, reroute (long haul) or delay movement. Preposition cargo at air transport site and transport earlier to avoid weather impacts.	48-96 hour forecast and current observation
Hurricane Force Winds (wind speed in mph and proximity to route or operational area in miles)	\geq 74 mph, \leq 50 miles	Road maintenance	Safety risks and travel delays, loss of visibility, loss of traction, impaired mobility, lane obstruction/submersion, loss of life, property damage, loss of communications/power	Predict threatened area, advise operators and travelers suspend outdoor operations, select treatment strategy, implement warning and evacuation plans. Mobilize maintenance forces.	48-96 hour forecast and current observation
		Truck operations	Safety risk to operators, freight/cargo damage risk, schedule delays, increased risk of collisions/spills of hazardous cargo	Advise operators and managers, conduct risk assessment. Delay, postpone, reschedule, or reroute as appropriate. If underway, especially when hauling hazardous materials, find a safe stopping point.	48-96 hour forecast and current observation
		U.S. Forest Service	Trapped, stranded, injured recreationists	Issue warnings and advisories. Implement search and rescue and evacuation plans as necessary.	48-96 hour forecast and current observation
		NASA (Goddard) spacecraft and equipment transport	Safety risk to transport vehicle operators, damage risk to unique cargo (spacecraft, vehicles, equipment), transport schedule delays, potential launch schedule delays	Advise transport operators, slow movement speeds when roads have been treated for ice conditions, reroute (long haul) or delay movement. Preposition cargo at air transport site and transport earlier to avoid weather impacts.	48-96 hour forecast and current observation
Tropical Storm Force Winds (wind speed in mph and proximity to route or operational area in miles)	\geq 39 mph to $<$ 74 mph, \leq 50 miles	Road maintenance	Safety risks and travel delays, loss of visibility, loss of traction, impaired mobility, lane obstruction/submersion, loss of life, property damage, loss of communications/power	Predict threatened area, advise operators and travelers suspend outdoor operations, select treatment strategy, implement warning and evacuation plans. Mobilize maintenance forces.	48-96 hour forecast and current observation

Weather Needs for Roadway Transportation

<u>Weather Element</u>	<u>Threshold</u>	<u>Activity</u>	<u>Impacts</u>	<u>Action</u>	<u>Lead Time</u>
		Truck operations	Safety risk to operators, freight/cargo damage risk, schedule delays, increased risk of collisions/spills of hazardous cargo	Advise operators and managers, conduct risk assessment. Delay, postpone, reschedule, or reroute as appropriate. If underway, especially when hauling hazardous materials, find a safe stopping point.	48-96 hour forecast and current observation
		U.S. Forest Service	Trapped, stranded, injured recreationists	Issue warnings and advisories. Implement search and rescue and evacuation plans as necessary.	48-96 hour forecast and current observation
		NASA (Goddard) spacecraft and equipment transport	Safety risk to transport vehicle operators, damage risk to unique cargo (spacecraft, vehicles, equipment), transport schedule delays, potential launch schedule delays	Advise transport operators, slow movement speeds when roads have been treated for ice conditions, rerout (long haul) or delay movement. Preposition cargo at air transport site and transport earlier to avoid weather impacts.	48-96 hour forecast and current observation
General Weather/Environmental Parameters					
Air Temperature Including Maximum and Minimum (degrees F)	Variable, based on impact criteria	Road maintenance	Air quality, loss of communications/power, precipitation type, pavement temperature, slope instability (avalanche risk), snow removal/ice treatment operations	Advise operators, monitor surface moisture, modify operations.	12-24 hour forecast and current observation
	Variable, trends and ranges based on impact criteria	Power generating operations	Power transmission loads and capacity affected by temperature extremes	Advise managers, operators, and line repair personnel.	7-13 days
Air Temperature (degrees F)	≥85-95	Road maintenance	Health and safety risk, engine/equipment heat stress	Advise operators, monitor personnel safety and equipment stress. Take prescribed actions	12-24 hours 3-6 hours
	≥85	Truck operations	Health and safety risk, engine/equipment heat stress	Advise operators, monitor personnel safety and equipment stress.	12 hours
	≥85-90	Driveaway-towaway (manufactured home transport)	Possible tire blow out on trailer	Reduce speed and check tire pressures.	6 hours
	≥85	Fleet utility and transport vehicle operations	Health and safety risk, engine/equipment heat stress	Advise operators, monitor personnel safety and equipment stress.	12 hours
	Variable, based on cargo humidity requirements	NASA (Goddard) spacecraft and equipment transport	Safety risk to transport vehicle operators, damage risk to unique cargo (spacecraft, vehicles, equipment)	Advise transport operators, ensure sufficient air conditioning equipment available to maintain cargo humidity requirements.	24 hours
	≥85	Bus operations	Health and safety risk, engine/equipment heat stress	Advise operators, monitor personnel safety and equipment stress. Ensure air conditioning units are operating properly.	12 hours
	≥85	Private vehicles	Health and safety risk, engine heat stress	Advise motorists.	12 hours
	≥85	State emergency management	Health and safety risk, engine/equipment heat stress	Advise operators.	12 hours
	≥85	State police	Health and safety risk, engine/equipment heat stress	Advise operators.	12 hours
Air Temperature (degrees F)	≥110	Road maintenance	Health and safety risk, engine/equipment heat stress	Advise operators, modify/restrict operations.	12-24 hours
				Take prescribed actions.	3-6 hours

Weather Needs for Roadway Transportation

Weather Element	Threshold	Activity	Impacts	Action	Lead Time
		Truck operations	Safety risk to operators, freight/cargo damage risk, schedule delays, increased risk of collisions/spills of hazardous cargo	Advise operators and managers, conduct risk assessment. Delay, postpone, reschedule, or reroute as appropriate.	12 hours
		Fleet utility and transport vehicle operations	Health and safety risk, engine/equipment heat stress	Advise operators, modify/restrict operations.	12 hours
		Bus operations	Health and safety risk, engine/equipment heat stress	Advise operators, monitor personnel safety and equipment stress. Ensure air conditioning units are operating properly.	12 hours
		Private vehicles	Health and safety risk, engine heat stress	Advise motorists to modify or restrict travel.	12 hours
		State emergency management	Health and safety risk, engine/equipment heat stress	Advise operators, modify/restrict operations.	12 hours
		State police	Health and safety risk, engine/equipment heat stress	Advise operators, modify/restrict operations.	12 hours
Air Temperature Relative to Freezing and Trend (degrees F and rising or falling trend)	Decrease to less than 32° or increase to exceed 32°, with moisture	Road maintenance	Safety and health risks, ice/snow removal operations affected, traveler delays	Provide early warning, advise operators and travelers. Monitor surface moisture. Begin treatment actions as appropriate.	12-24 hours 3-6 hours
		Truck operations	Safety and health risks, potential operational delays	Advise operators, monitor surface moisture.	12 hours
		Driveaway-towaway (manufactured home transport)	loss of control on icy roads, trailer handling difficulties on changing surface conditions.	Advise operators to adjust speed or avoid the area.	12 hours
		Fleet utility and transport vehicle operations	Safety and health risks, potential operational delays	Advise operators, monitor surface moisture.	12 hours
		Bus operations	Safety and health risks, potential operational delays	Advise operators, monitor surface moisture.	12 hours
		Private vehicles	Safety and health risks, potential operational delays	Advise operators, monitor surface moisture.	12 hours
		State emergency management	Operations affected by ice formation	Advise operators, monitor surface moisture.	12 hours
		State police	Operations affected by ice formation	Advise operators, monitor surface moisture.	12 hours
		U.S. Forest Service	Logging hauling operations on frozen/snow packed roads affected by melt/thaw (Thawing may penetrate/damage structural support of roads and shut down heavy truck hauling.)	Place thermistors in roads to monitor melt/thaw and road integrity.	12-24 hours
Dew Point Temperature (degrees F)	Variable, based on temperature and impact criteria	Road maintenance	Precipitation type, fog formation, air quality, slope instability (avalanche risk), snow removal/ice treatment operations	Predict threatened area, select treatment strategy, advise operators. Monitor surface moisture, modify operations.	12-24 hour forecast and current observation
	Variable, based on cargo humidity requirements	NASA (Goddard) spacecraft and equipment transport	Safety risk to transport vehicle operators, damage risk to unique cargo (Spacecraft, vehicles, and equipment must be maintained at specified humidity thresholds.)	Advise transport operators, ensure sufficient air conditioning equipment available to maintain cargo humidity requirements.	12-24 hour forecast and current observation
Air Temperature Change Rate (degrees F per 24 hours)	Approx. 60°	Road maintenance	Precipitation type, pavement temperature, pavement buckling damage due to rapid expansion and contraction	Predict threatened area, select treatment strategy. Repair roadways.	12-24 hour forecast and current observation
Time and Air Temperature Integrals (heating/cooling degree days)	Variable	Road maintenance	Road/property damage risk under extreme heating degree days or cooling degree days	Determine stockpile or resources needed to repair damage.	Forecast and actual tally

Weather Needs for Roadway Transportation

<u>Weather Element</u>	<u>Threshold</u>	<u>Activity</u>	<u>Impacts</u>	<u>Action</u>	<u>Lead Time</u>
Wet Bulb Temperature (degrees F)	Variable, based on temperature and impact criteria	Road maintenance	Air temperature, fog dispersal effectiveness	Predict threatened area, select treatment strategy. Disperse fog (cold fog) using CQ application.	12-24 hour forecast and current observation
Relative Humidity (percent)	Variable, based on impact criteria	Road maintenance	Precipitation type, visibility restrictions	Predict threatened area, select treatment strategy.	12-24 hour forecast and current observation
	Variable, based on cargo humidity requirements	NASA (Goddard) spacecraft and equipment transport	Safety risk to transport vehicle operators, damage risk to unique cargo (Spacecraft, vehicles, and equipment must be maintained at specified humidity thresholds.)	Advise transport operators, ensure sufficient air conditioning equipment available to maintain cargo humidity requirements.	12-24 hour forecast and current observation
Air Stability	Stable/unstable	Road maintenance	Air quality (Stable atmosphere inhibits dispersion of pollutants.)	Modify operations.	12-24 hour forecast and current observation
		Atmospheric transport & diffusion & HAZMAT response	Health and safety risks, operational delays (Stable atmosphere inhibits dispersion of hazardous materials.)	Initiate HAZMAT (hazardous materials) spill reaction and mitigation plan. Ensure proper authorities are notified.	1-3 hours
Subsurface Temperature (degrees F)	Variable, based on other contributing factors such as wind, shade, sun	Road maintenance	Pavement effects (Subsurface temperature affects pavement temperature, along with wind, insolation, shade, and other contributing factors.)	Predict threatened area, select treatment strategy	12-24 hour forecast and current observation
Pavement Freeze Point Temperature with Dew Point Temperature (degrees F)	≤32° with moisture (observation and forecast)	Road maintenance	Loss of traction, safety risk to maintenance personnel and motorists, impacts on preventative treatment of roadways for ice (Some ice-preventative treatment operations can be completed in one shift; others require two shifts.) Operational delays, increased workload, anti-icing and/or de-icing operations required	Select treatment strategy, advise operators. Begin preparation procedures for applying chemicals (prepare liquid chemical tanks or hoppers for salt application) 12 hours prior to time for applying treatment to roadways.	Current observation and 12-48 hour forecast
				Treat/clear roadways with anti-icing, de-icing treatments. Adjust traffic flow management.	12 hours
	≤32° with moisture	Truck operations	Safety risk to operators, freight/cargo damage risk, schedule delays, increased risk of collisions/spills of hazardous cargo	Advise operators and managers, conduct risk assessment. Delay, postpone, reschedule, or reroute as appropriate. If underway, especially when hauling hazardous materials, find a safe stopping point.	12 hours
		Driveaway-towaway (manufactured home transport)	Possible loss of control due to icy road surface.	Reduce speed and exercise caution.	6 hours
		Fleet utility and transport vehicle operations	Safety risk to operators, damage risk, schedule delays	Advise operators, reschedule, reroute.	12 hours
		Bus operations	Safety risk to operators/passengers, schedule delays	Advise operators, reschedule, reroute.	12 hours
Private vehicles	Safety risk to motorists, travel delays	Advise motorists, reschedule, reroute.	12 hours		

Weather Needs for Roadway Transportation

<u>Weather Element</u>	<u>Threshold</u>	<u>Activity</u>	<u>Impacts</u>	<u>Action</u>	<u>Lead Time</u>
		State emergency management	Safety risk to motorists, hazardous cargo risks	Advise operators, reschedule.	12 hours
		State police	Increased workload due to hazardous travel conditions	Advise operators, reschedule, adjust traffic management.	12 hours
Pavement Temperature (degrees F)	>85°	Road maintenance	Personnel health and safety, engine/equipment heat stress, pavement buckling	Provide early warning, monitor equipment and personnel for heat stress, modify maintenance activities as required. Take prescribed health/safety and repair actions.	12-24 hours 3 hours
	>90°	Driveaway-towaway (manufactured home transport)	Possible tire blow out on trailer	Reduce speed and check tire pressures.	6 hours
Pavement Temperature when Moisture is Present (degrees F)	>(15-18°) but <32°	Road maintenance	Effects on snow/ice bonding and on snow removal/ice treatment operations, loss of traction	Predict threatened area, select treatment strategy. Prepare, deploy and track treatment assets. Apply treatment chemicals/abrasives.	12 hours
	<15-18°		Effects on snow/ice bonding and on snow removal/ice treatment operations, loss of traction, changes in treatment chemical effectiveness	Predict threatened area, select treatment strategy. Prepare, deploy, and track treatment assets. Plow snow, apply abrasives.	12 hours
Pavement Temperature	Variable, based on impact criteria	Road maintenance	Effects on snow/ice bonding and snow removal/ice treatment operations, loss of traction, changes in treatment chemical effectiveness and snow/ice melting	Predict threatened area, select treatment strategy. Prepare, deploy and track treatment assets. Plow snow apply treatment chemicals/abrasives.	Current observation
Pavement Condition	Wet	Road maintenance	Impaired mobility, loss of traction, loss of stability/maneuverability, safety risk	Predict threatened area, manage traffic flow.	Current observation
	Snow, snowpack	Road maintenance	Impaired mobility, loss of traction, loss of stability/maneuverability, safety risk	Predict threatened area, select treatment strategy. Prepare, deploy and track treatment assets. Apply treatment chemicals/abrasives, plow snow, manage traffic flow.	Current observation
	Ice	Road maintenance	Impaired mobility, loss of traction, loss of stability/maneuverability, safety risk	Predict threatened area, select treatment strategy, prepare, deploy and track treatment assets, apply treatment chemicals/abrasives, manage traffic flow.	Current observation
Chemical Concentration (in-road sensor or mobile infrared)	Variable, based on application, residue	Road maintenance	Safety risk, snow removal/ice treatment operations, snow/ice bonding	Select treatment strategy, deploy and track treatment assets. Apply treatment chemicals/abrasives, operate outflow devices.	Current observation
Visibility, Including Restricting Conditions such as Fog, Haze, Dust, Smoke (statute miles)	<1/4 to ≤ 1/2 mile	Road maintenance	Safety risk, loss of visibility, impaired mobility	Provide early warning to operators and motorists. Take prescribed actions, advise operators and maintenance personnel. Modify operations, consider application of CO ₂ to disperse fog.	6-12 hours 3-6 hours and current observation
		Truck operations	Safety risk to operators, freight/cargo damage risk, schedule delays, increased risk of collisions/spills of hazardous cargo	Advise operators and managers, conduct risk assessment. Delay, postpone, reschedule, or reroute as appropriate. If underway, especially when hauling hazardous materials, find a safe stopping point.	6 hours
	Driveaway-towaway (manufactured home transport)	Ability to see and be seen within safe reaction distance greatly reduced	Stop travel.	3 hours	
	Fleet utility and transport vehicle operations	Safety risk, schedule delays	Advise operators, modify operations.	6 hours	

Weather Needs for Roadway Transportation

<u>Weather Element</u>	<u>Threshold</u>	<u>Activity</u>	<u>Impacts</u>	<u>Action</u>	<u>Lead Time</u>
		NASA (Goddard) spacecraft and equipment transport	Safety risk to transport vehicle operators, damage risk to unique cargo (spacecraft, vehicles, equipment), transport schedule delays, potential launch schedule delays	Advise transport operators, slow movement speeds, reroute (long haul) or delay movement, preposition cargo at air transport site and transport earlier to avoid weather impacts	6 hours
		Bus operations	Safety risk, schedule delays	Advise operators, modify operations, reduce speeds.	6 hours
		Private vehicles	Safety risk, travel delays	Advise motorists, modify travel.	6 hours
		State emergency management	Transport risk to hazardous cargo	Advise operators, modify operations.	6 hours
		State police	Increased workload due to hazardous travel conditions	Advise operators, modify operations.	6 hours
Sun Glare	Any	Road maintenance	Restricted visibility in glare quadrant of horizon	Advise operators and maintenance personnel, reduce speed.	3 hours and current observation
		Truck operations	Restricted visibility in glare quadrant of horizon, safety risk to operators, freight/cargo damage risk, schedule delays, increased risk of collisions/spills of hazardous cargo	Advise operators, reduce speed.	3 hours
		Fleet utility and transport vehicle operations	Restricted visibility in glare quadrant of horizon	Advise operators, reduce speed.	3 hours
		NASA (Goddard) spacecraft and equipment transport	Restricted visibility in glare quadrant of horizon, safety risk to transport vehicle operators, damage risk to unique cargo (spacecraft, vehicles, equipment)	Advise transport operators, slow movement speeds.	3 hours
		Bus operations	Restricted visibility in glare quadrant of horizon	Advise operators, reduce speed.	3 hours
		Private vehicles	Restricted visibility in glare quadrant of horizon	Advise motorists, reduce speed.	3 hours
		State emergency management	Restricted visibility in glare quadrant of horizon	Advise operators, reduce speed.	3 hours
		State police	Restricted visibility in glare quadrant of horizon	Advise operators, reduce speed.	3 hours
Wind: Head, Cross, or Tail (wind speed in miles per hour)	>30 and <50 mph	Road maintenance	Safety risk to personnel and motorists, increased roadway and lane obstruction (debris), reduced or lost visibility, drifting snow, loss of stability and maneuverability, road damage, loss of life or property, treatment chemical dispersion, loss of communications and power, toxicity and environmental damage (Speed and direction are most important when snow has accumulated.)	Predict threatened area, advise travelers, select treatment strategy, implement early warning procedures. Consider implementation of evacuation plans. Construct and place living and structural snow fences to manage snow drifting.	12-24 hours
				Modify operations, prepare for snow drift removal. Manage traffic flow (restrict access to roadways and bridges, restrict access to specific vehicle types), remove debris, repair damage.	6-12 hours and current observation
	>30 and <50 mph	Truck operations	Safety risk to operators, freight/cargo damage risk, schedule delays, increased risk of collisions/spills of hazardous cargo	Advise operators and managers, conduct risk assessment. Delay, postpone, reschedule, or reroute as appropriate. If underway, especially when hauling hazardous materials, find a safe stopping point.	12 hours
	>25 mph and gusty	Driveaway-towaway (manufactured home transport)	Difficult handling of trailer and load (manufactured home or section)	Stop travel.	6 hours
>30 and <50 mph	Fleet utility and transport vehicle operations	Safety risk to operators	Advise operators, modify operations.	12 hours	

Weather Needs for Roadway Transportation

<u>Weather Element</u>	<u>Threshold</u>	<u>Activity</u>	<u>Impacts</u>	<u>Action</u>	<u>Lead Time</u>
	>30 mph	NASA (Goddard) spacecraft and equipment transport	Safety risk to transport vehicle operators, damage risk to unique cargo (spacecraft, vehicles, equipment), transport schedule delays, potential launch schedule delays	Advise transport operators, slow movement speeds, reroute (long haul) or delay movement. Preposition cargo at air transport site and transport earlier to avoid weather impacts	24-48 hours
	>30 and <50 mph	Bus operations	Increased safety risk, roadway debris, flying debris, traffic congestion, downed live electric lines and or poles, increased risk of damage to busses and property, schedule delays	Advise operators, plan route detours. If high wind watches issued, modify, restrict, or suspend operations. Notify passengers (public address system).	6 hours
	>30 and <50 mph	Private vehicles	Safety risk to operators/passengers	Advise motorists, modify travel.	6 hours
	>30 and <50 mph	State emergency management	Transport risk to hazardous cargo	Advise operators, modify operations.	6 hours
	>30 and <50 mph	State police	Increased workload due to hazardous travel conditions	Advise operators, modify operations.	6 hours
	>35 mph and sustained	Power generating operations	Line damage, transmission impairment or loss	Alert managers, dispatch line repair personnel as needed.	48, 24, and 12 hours
Wind: Head, Cross, or Tail (wind speed in miles per hour)	≥50 mph	Road maintenance	Safety risk to personnel and motorists, increased roadway and lane obstruction (debris), reduced or lost visibility, impaired mobility, drifting snow, loss of stability and maneuverability, road damage, loss of life or property, treatment chemical dispersion, loss of communications and power, toxicity and environmental damage (Speed and direction are most important when snow has accumulated.)	Predict threatened area, advise travelers, select treatment strategy, implement early warning procedures. Review and consider implementation of evacuation plans. Construct and place living and structural snow fences to manage snow drifting.	12-24 hours
				Modify operations, implement snow removal. Manage traffic flow (restrict access to roadways and bridges, restrict access to specific vehicle types), remove debris repair damage.	6-12 hours
		Truck operations	Safety risk to operators, freight/cargo damage risk, schedule delays, increased risk of collisions/spills of hazardous cargo	Advise operators and managers, conduct risk assessment. Delay, postpone, reschedule, or reroute as appropriate. If underway, especially when hauling hazardous materials, find a safe stopping point.	12 hours
		Fleet utility and transport vehicle operations	Safety risk to operators	Advise operators, reschedule, reroute.	12 hours
		Bus operations	Increased safety risk, roadway debris, flying debris, traffic congestion, downed live electric lines and or poles, increased risk of damage to busses and property, schedule delays, detours required on routes	Advise operators, plan route detours. If high wind watches issued, modify, restrict, or suspend operations. Notify passengers (public address system).	6 hours
		Private vehicles	Safety risk to operators/passengers	Advise motorists, reschedule, reroute.	6 hours
		State emergency management	Transport risk to hazardous cargo	Advise operators, plan route detours. If high wind watches issued, modify, restrict, or suspend operations. Notify passengers (public address system).	6 hours
		State police	Increased workload due to hazardous travel conditions	Advise operators, reschedule, adjust traffic management.	6 hours
		U.S. Forest Service	Access roads blocked by debris and felled timber, valuable timber blown down/damaged (Downed timber requires timely salvage before its value is lost.)	Move in emergency equipment to clear roadways and perform timber salvage operations. Determine where downed timber and blocked roads may have occurred in remote areas without depending on visual observations and field reports. Determine track using weather radar, etc.	3 hours Current observation

Weather Needs for Roadway Transportation

<u>Weather Element</u>	<u>Threshold</u>	<u>Activity</u>	<u>Impacts</u>	<u>Action</u>	<u>Lead Time</u>
Surface Wind Direction	Any speed	Road maintenance	Drifting snow, wild fire tracking, toxicity and environmental damage	Predict threatened area, select treatment strategy. Remove debris, repair damage.	2 hour forecast and current observation
Upper Air Winds	Standard levels	Road maintenance	Air quality, storm cell tracking, toxicity and environmental damage	Predict threatened area, select treatment strategy. Remove debris, repair damage.	12 hours and most recent upper air data
Wind Chill (degrees F)	$\leq 32^{\circ}$	Road maintenance	Safety risks (hypothermia, frost bite)	Provide early warning. Advise maintenance personnel, cancel/curtail operations.	12-24 hours 3-6 hours and current observation
		$\leq 20^{\circ}$	Truck operations	Safety risks (hypothermia, frost bite)	Advise operators, modify operations.
		Driveaway-towaway (manufactured home transport)	Safety risks for drivers (hypothermia, frost bite)	Advise operators and minimize outside exposure.	6 hours
		Fleet utility and transport vehicle operations	Safety risks (hypothermia, frost bite)	Advise operators, modify operations	6 hours
		NASA (Goddard) spacecraft and equipment transport	Safety risks (hypothermia, frost bite)	Advise operators, delay operations.	6 hours
		Bus operations	Safety risks (hypothermia, frost bite)	Advise operators, modify operations.	6 hours
		Private vehicles	Safety risks (hypothermia, frost bite)	Advise motorists, modify travel.	6 hours
		State emergency management	Safety risks (hypothermia, frost bite)	Advise operators, modify operations.	6 hours
		State police	Safety risks (hypothermia, frost bite)	Advise operators, modify operations.	6 hours
Heat Index (degrees F)	$\geq 105^{\circ}$	Road maintenance	Personnel heat exhaustion	Provide early warning. Advise operators, modify/restrict operations.	12-24 hours 3-6 hours
		Truck operations	Personnel heat exhaustion	Advise operators, modify/restrict operations.	6 hours
		Driveaway-towaway (manufactured home transport)	Safety risk for driver (heat exhaustion)	Advise operator, have water available, exercise caution.	6 hours
		Fleet utility and transport vehicle operations	Personnel heat exhaustion	Advise operators, modify/restrict operations.	6 hours
		NASA (Goddard) spacecraft and equipment transport	Personnel heat exhaustion	Advise operators, modify/restrict operations.	6 hours
		Bus operations	Personnel heat exhaustion	Advise operators, modify/restrict operations.	6 hours
		Private vehicles	Personnel heat exhaustion	Advise motorists, modify/restrict travel.	6 hours
		State emergency management	Personnel heat exhaustion	Advise operators, modify/restrict operations.	6 hours
			State police	Personnel heat exhaustion	Advise operators, modify/restrict operations.
		variable extremes based on impact criteria	Power generating operations	Existing and anticipated power loads and transmission capacities altered by temperature extremes	Adjust marketing strategies to ensure cost effective transmissions. Advise managers, alert operators and line repair personnel.
Air Quality	Code orange or red	Road maintenance	Potential health and safety risks, operational delays	Provide early warning, advise operators, modify operations in urban areas.	12-24 hours
				Modify operations in urban areas.	3-6 hours

Weather Needs for Roadway Transportation

<u>Weather Element</u>	<u>Threshold</u>	<u>Activity</u>	<u>Impacts</u>	<u>Action</u>	<u>Lead Time</u>
		Truck operations	Potential health and safety risks, operational delays	Advise operators, modify operations in urban areas.	12 hours
		Fleet utility and transport vehicle operations	Potential health and safety risks, operational delays	Advise operators, modify operations in urban areas.	12 hours
		Bus operations	Potential health and safety risks, operational delays	Advise operators, modify operations in urban areas.	12 hours
		Private vehicles	Potential health and safety risks, operational delays	Advise motorists, modify travel in urban areas.	12 hours
		State emergency management	Potential health and safety risks, operational delays	Advise operators.	12 hours
		State police	Potential health and safety risks, operational delays	Advise operators.	12 hours
		Atmospheric Transport and Diffusion and HAZMAT response	Potential health and safety risks, operational delays	Initiate HAZMAT spill reaction and mitigation plan. Ensure proper authorities are notified.	1-3 hours
Space Weather (solar flares, etc.)	Any	Road maintenance	Possible loss of communications, power, GPS navigation	Advise operators, monitor communication outages.	12 hour forecast and current observation
		Truck operations	Possible loss of communications, power, GPS navigation	Advise operators, monitor communication outages.	12 hours
		Fleet utility and transport vehicle operations	Possible loss of communications, power, GPS navigation	Advise operators, monitor communication outages.	12 hours
		NASA (Goddard) spacecraft and equipment transport	Possible loss of communications, power, GPS navigation	Advise operators, monitor communication outages.	12 hours
		Bus operations	Possible loss of communications, power, GPS navigation	Advise operators, monitor communication outages.	12 hours
		Private vehicles	Possible loss of communications, power, GPS navigation	Advise operators, monitor communication outages.	12 hours
		State emergency management	Possible loss of communications, power, GPS navigation	Advise operators, monitor communication outages.	12 hours
		State police	Possible loss of communications, power, GPS navigation	Advise operators, monitor communication outages.	12 hours
		U.S. Forest Service	Possible loss of communications, power, GPS navigation	Advise operators, monitor communication outages.	12 hours
Total Sun (insolation hours per day)	All	Road maintenance	Air temperature, pavement temperature, toxicity, and environmental damage	Modify operations as necessary.	12-24 hour forecast and current observation
Cloud Cover Forecast	Scattered, broken, overcast	Road maintenance	Air temperature, pavement temperature, toxicity, and environmental damage	Modify operations as necessary.	12-24 hour forecast and current observation
Water Course Flow Volume (cubic meters per second)	Variable, based on flood stage criteria	Road maintenance	Flood risk, lane submersion, loss of life and property, road damage	Predict threatened area, select treatment strategy, operate outflow devices, develop warning and evacuation plans.	12-24 hour forecast and current observation
		U.S. Forest Service	Flood risk, road submersion, loss of life and property, road damage	Predict threatened area, operate outflow devices, develop warning and evacuation plans.	12-24 hour forecast and current observation

Weather Needs for Roadway Transportation

<u>Weather Element</u>	<u>Threshold</u>	<u>Activity</u>	<u>Impacts</u>	<u>Action</u>	<u>Lead Time</u>
		State emergency management	Transport risk to hazardous cargo	Advise operators.	12-24 hour forecast and current observation
Water Body Depth (feet)	Variable, based on flood stage criteria	Road maintenance	Flood risk, lane submersion, loss of life and property, road damage	Predict threatened area, select treatment strategy, operate outflow devices, develop warning and evacuation plans.	12-24 hour forecast and current observation
		U.S. Forest Service	Flood risk, road submersion, loss of life and property, road damage	Predict threatened area, operate outflow devices, develop warning and evacuation plans.	12-24 hour forecast and current observation
		State emergency management	Transport risk to hazardous cargo	Advise operators.	12-24 hour forecast and current observation
Hurricane Storm Surge	Any	Road maintenance	Safety risk, damage to vehicles, road damage, evacuation route delays	Predict threatened area, repair damage.	12-24 hour forecast and current observation
		Truck operations	Safety risk, damage to vehicles, road damage, evacuation route delays	Advise operators. Reroute or suspend operations.	12-24 hour forecast and current observation
		Fleet utility and transport vehicle operations	Safety risk, damage to vehicles, road damage, evacuation route delays	Advise operators. Reroute or suspend operations.	12-24 hour forecast and current observation
		NASA (Goddard) spacecraft and equipment transport	Safety risk, damage to vehicles, road damage, evacuation route delays	Advise operators. Reroute or delay transport operations.	12-24 hour forecast and current observation
		Bus operations	Increased safety risk, damage to busses, delays to scheduled operations, complete disruption of service for busses that travel coastal roads	Advise operators and road supervisors of pending conditions. Modify, restrict, or suspend operations. Request radio reports of observed storm surge crossing the highway.	12-24 hour forecast and current observation
		Private vehicles	Safety risk, damage to vehicles, road damage, evacuation route delays	Advise motorists. Reroute, restrict, or suspend travel.	12-24 hour forecast and current observation
		State emergency management	Safety risk, damage to vehicles, road damage, evacuation route delays	Implement emergency response procedures as appropriate.	12-24 hour forecast and current observation
		State police	Safety risk, damage to vehicles, road damage, evacuation route delays	Implement emergency response procedures as appropriate.	12-24 hour forecast and current observation
		U.S. Forest Service	Potential safety risks, stranded recreationists	Advise field personnel and recreationists.	24 hours and current observation

Weather Needs for Roadway Transportation

<u>Weather Element</u>	<u>Threshold</u>	<u>Activity</u>	<u>Impacts</u>	<u>Action</u>	<u>Lead Time</u>
High Surf (wave height in feet)	>8 feet	Road maintenance	Safety risk, damage to vehicles, road damage, evacuation route delays	Predict threatened area, repair damage.	12-24 hour forecast and current observation
Avalanche Danger	High, moderate, low	Road maintenance	Impaired mobility, loss of life and property, lane obstruction, effects on snow removal/ice treatment operations	Close roadways, release avalanche, remove snow, modify operations as necessary.	12-24 hour forecast and current observation
		U.S. Forest Service	Life threat, safety risk to recreationalists, Forest Service workers	Pass warnings to forest users, workers.	12-24 hour forecast and current observation
Seismic Activity	Any seismic activity	Road maintenance	Road/property damage risk, impaired mobility, loss of life and property	Manage traffic flow, modify operations, remove debris, repair damage.	12-24 hour forecast and current observation
		U.S. Forest Service	Life threat, safety risk to recreationalists, Forest Service workers	Pass warnings to forest users, workers.	12-24 hour forecast and current observation
		NASA (Goddard) spacecraft and equipment transport	Safety risk to transport vehicle operators, damage risk to unique cargo (spacecraft/vehicles/equipment), transport schedule delays, potential launch schedule delays	Advise transport operators. Reroute (long haul) or delay movement.	12-24 hour forecast and current observation
Volcanism	Any volcanic activity	Road maintenance	Road/property damage risk, impaired mobility, loss of life and property, air quality	Manage traffic flow, modify operations.	12-24 hour forecast and current observation
		U.S. Forest Service	Cataclysmic devastation of large areas (Mt. St. Helens National Monument is administered by the Forest Service. Many dormant volcanos are on National Forest land: Shasta, Medicine Lake, Three Sisters, Mt. Hood, etc.)	Issue warnings and advisories. Implement search and rescue or evacuation plans, as necessary.	12-24 hour forecast and current observation
		NASA (Goddard) spacecraft and equipment transport	Safety risk to transport vehicle operators, damage risk to unique cargo (spacecraft, vehicles, equipment), transport schedule delays, potential launch schedule delays	Advise transport operators. Reroute (long haul) or delay movement.	12-24 hour forecast and current observation
Soil Moisture	Saturated, unsaturated	Road maintenance	Flood risk, road/pavement damage, pavement condition	Select treatment strategy, select road repair strategy.	12-24 hour forecast and current observation
Fire	Any fire event or activity	Road maintenance	Loss of visibility, loss of life and property, air quality	Manage traffic flow (close roadways, bridges).	12-24 hour forecast and current observation
		U.S. Forest Service	Life threat, safety risk	Conduct fire fighting operations.	12-24 hour forecast and current observation

Weather Needs for Roadway Transportation

<u>Weather Element</u>	<u>Threshold</u>	<u>Activity</u>	<u>Impacts</u>	<u>Action</u>	<u>Lead Time</u>
		NASA (Goddard) spacecraft and equipment transport	Safety risk to transport vehicle operators, damage risk to unique cargo (spacecraft, vehicles, equipment), transport schedule delays, potential launch schedule delays	Advise transport operators. Reroute (long haul) or delay movement.	12-24 hour forecast and current observation
Fair Weather (duration in days)	1 to 10 days	Road maintenance	Operational planning (The tasks that will be undertaken in periods of good weather depend somewhat on how much good weather is anticipated. Crews work year round; there are no reserves or part-time personnel to call in for snow or other severe weather events. Details of crew assignments vary day to day, some days plowing and sanding, some days working on drainage, some days on signs and guardrail, etc. A certain amount of mobilization is required for some tasks.)	Examples: (1) Ditching requires removing the sanders, mounting a truck box, and replacing the blower attachment on a loader with a bucket. These jobs would probably take 2 days. Such actions cannot be started without a forecast of 10 days of good (non-snow) weather because of the time needed to reconvert the equipment. (2) In urban areas, snow hauling is necessary following a storm. The same amount of work is needed to clean up after a 6-inch fall as a 12-inch one. If good weather is forecast following a 6" snow event, hauling might be started. If another snow event is forecast within several days, hauling may be delayed. (3) Forecasts of good weather, as well as bad, aid managers in deploying crews efficiently.	24-48 hours
	Variable, based on impact criteria	Truck operations	Risks to weather sensitive operations, cargo, or time constraints	Carry out operations and travel/transport schedules, based on forecast of fair weather for specific period.	24-48 hours
		Fleet utility and transport vehicle operations	Risks to weather sensitive operations, cargo, or time constraints	Carry out operations and travel/transport schedules, based on forecast of fair weather for specific period.	24-48 hours
		NASA (Goddard) spacecraft and equipment transport	Risks to weather sensitive operations, cargo with unique weather parameter requirements, or travel time requirements	Carry out operations and travel/transport schedules, based on forecast of fair weather for specific period.	24-48 hours
		Bus operations	Risks to weather sensitive operations or time constraints	Carry out operations and travel/transport schedules, based on forecast of fair weather for specific period.	24-48 hours
		Private vehicles	Risks to weather sensitive travel or travel time requirements	Carry out operations and travel/transport schedules, based on forecast of fair weather for specific period.	24-48 hours
		State emergency management	Risks to weather sensitive operations, cargo with unique weather parameter requirements, or travel time requirements	Carry out operations and travel/transport schedules, based on forecast of fair weather for specific period.	24-48 hours
		State police	Risks to weather sensitive operations or time requirements	Carry out operations and travel/transport schedules, based on forecast of fair weather for specific period.	24-48 hours
	1 to 10 days of mean temperatures >50-60° F	U.S. Forest Service	Risks to seal coating operations (Resurfacing of roads with road oil and gravel to seal road cracks is often done during the fall. Seal coating fails if temperatures fall below 50-60° F during resurfacing.)	Carry out operations and travel/transport schedules, based on forecast of fair weather for specific period.	24-48 hours
Nuclear, Biological, or Chemical Release	Any	Road maintenance	Severe threat to life, health and safety risks from dispersion of extremely dangerous hazardous materials, agents, substances	Close or detour roadways. Assist in Atmospheric Transport and Diffusion and HAZMAT response operations as needed.	1-3 hours current observation
		Truck operations	Severe threat to life, health and safety risks from dispersion of extremely dangerous hazardous materials, agents, substances	Cease transport operations/travel or reroute.	1-3 hours current observation
		Fleet Utility and Transport Vehicle Operations	Severe threat to life, health and safety risks from dispersion of extremely dangerous hazardous materials, agents, substances	Cease transport operations/travel or reroute.	1-3 hours current observation

Weather Needs for Roadway Transportation

<u>Weather Element</u>	<u>Threshold</u>	<u>Activity</u>	<u>Impacts</u>	<u>Action</u>	<u>Lead Time</u>
		Fleet utility and transport vehicle operations	Severe threat to life, health and safety risks from dispersion of extremely dangerous hazardous materials, agents, substances	Cease transport operations/travel or reroute.	1-3 hours current observation
		NASA (Goddard) spacecraft and equipment transport	Severe threat to life, health and safety risks from dispersion of extremely dangerous hazardous materials, agents, substances	Cease transport operations/travel or reroute.	1-3 hours current observation
		Bus operations	Severe threat to life, health and safety risks from dispersion of extremely dangerous hazardous materials, agents, substances	Cease transport operations/travel or reroute.	1-3 hours current observation
		Private vehicles	Severe threat to life, health and safety risks from dispersion of extremely dangerous hazardous materials, agents, substances	Cease transport operations/travel or reroute.	1-3 hours current observation
		State emergency management	Severe threat to life, health and safety risks from dispersion of extremely dangerous hazardous materials, agents, substances	Close or detour roadways. Implement Atmospheric Transport and Diffusion and HAZMAT response operations as needed.	1-3 hours current observation
		State police	Severe threat to life, health and safety risks from dispersion of extremely dangerous hazardous materials, agents, substances	Close or detour roadways. Assist in Atmospheric Transport and Diffusion and HAZMAT response operations as needed.	1-3 hours current observation
		U.S. Forest Service	Severe threat to life, health and safety risks from dispersion of extremely dangerous hazardous materials, agents, substances	Close or detour roadways. Assist in Atmospheric Transport and Diffusion and HAZMAT response operations as needed.	1-3 hours current observation